U. S. FOREST SERVICE

RESEARCH NOTE LS-46

LAKE STATES FOREST EXPERIMENT STATION • U. S. DEPARTMENT OF AGRICULTURE

Twenty-Two-Year Results of a Precommercial Thinning Experiment in Jack Pine

In August 1936 a forest fire burned 30,000 acres in northeastern Minnesota. Half of the burn was on the Aurora District of the Superior National Forest. A 150-acre tract was seeded to jack pine in April 1937 with unexpected success.[1] By 1941 portions of the stand contained more than 10,000 stems per acre.

An experiment in precommercial thinning was installed in the stand in the fall of 1941. The spacing treatments are 4x4, 6x6, and 8x8 feet plus unthinned controls. The individual treatments are replicated three times in ½-acre plots in a randomized block design. Except for a slight fertility gradient the stand is uniform; the growth responses among the three replications are more consistent than is commonly found in experiments of this kind. The experiment was measured at ages 10, 16, 22, and 27 years. Site index is 70 feet at 50 years, which is excellent for jack pine.

In November 1947 a heavy wet snow flattened patches and strips in the control plots, in the adjacent unthinned stand, and in plots thinned the previous year at age 10. This damage resulted in openings or partially occupied growing space approximately 10 to 20 feet across in portions of the unthinned plots. The thinning treatments at age 5 suffered little damage from the 1947 storm; the plots thinned at age 10 were severely damaged and are not included in this analysis. Additional background and early results for the experiment were previously reported by Roe and Stoeckeler.[2]

Stand Growth

Stand characteristics at age 27 (22 years after thinning) are given in table 1 and described below:

1. Average height of dominants and codominants, including the unthinned plots, has not been significantly affected by spacing.

2. Basal area and total cubic-foot volume are greatest in the 4x4-foot spacing, next on the 6x6, and least in the 8x8. The unthinned plots are presently intermediate between the 6x6 and the 8x8-foot spacings in both basal area and volume. Had the patchwork storm damage at age 11 not occurred, the unthinned plots would now have the greatest basal area and volume per acre. Subplots in the portions of the unthinned stand not damaged by the 1947 storm currently have 150-165 square feet of basal area and 2,500-2,800 cubic feet per acre.

3. The live crown has receded most on the close spacings. Height to the first live branch and height to full crown (defined as the minimum height at which each one-third sector of the crown, divided vertically, contains live branches) are greater with close spacings.

4. Average branch diameters (measured 0.25 foot from the bole in a section from 6 to 12 feet above the ground) increase with wider spacings. All branches in this bole section are dead. There is no statistical difference between spacings in the number persisting to this date. (The average is 41 branches per tree in the 6-foot bole section.)

5. Average tree diameter (the tree of average basal area) for the 8x8-foot, 6x6-foot, 4x4-foot, and unthinned stands is 5.8, 5.1, 4.1, and 3.5 inches, respectively. Probably all trees on the 8x8-foot spacing will reach merchantable size (presently about 6 inches d.b.h.), as will most on the 6x6-foot spacing; but there will be additional mortality from suppression on the 4x4-foot and unthinned plots. Control of tree size is the chief silvicultural advantage of precommercial thinning.

Stand Taper

Trees were measured to determine the effect of spacing on average taper in the first 20 feet of stand height. Diameters to the nearest 0.10 inch were measured at 0.5, 4.5, 8.0, 12.0, 16.0, and 20.0 feet above ground on 14 trees mechanically chosen on each of the thinned plots. Average diameters, and the ratio of diameter at various heights to the diameter at breast height were computed (table 2). Cubic-foot volumes for each bole section were also calculated.

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1 *Roe, Eugene I. Seeding jack pine after fire in Minnesota. Forest and Outdoors 47(10): 20-22, illus. 1951.*

2 *Roe, Eugene I., and Stoeckeler, Joseph H. Thinning over-dense jack pine seedling stands in the Lake States. Jour. Forestry 48: 861-865. 1950.*

MAINTAINED AT ST. PAUL 1, MINNESOTA, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

TABLE 1. — *Stand and tree characteristics at age 27 of jack pine precommercially thinned at age 5*

Characteristics of stand and trees	Spacing			
	4x4 feet	6x6 feet	8x8 feet	Control (unthinned)
Number of trees per acre	1,632	950	615	1,809
Basal area per acre (square feet)	147	136	113	123
Cubic-foot volume per acre (inside bark)	2,480	2,290	1,900	2,070
Average height of dominants and codominants (feet)	42	42	41	40
Height to first live limb (feet)	25	23	19	(1)
Height to total crown (feet)	27	25	23	(1)
Average limb diameter (inches)	0.36	0.46	0.54	(1)
Diameter of tree of average basal area (inches)	4.1	5.1	5.8	3.5

1 *Not measured.*

TABLE 2. — *Diameters at various heights, ratios to diameter at breast height, and cubic feet of volume per square foot of basal area*

Height (feet)	Spacing, in feet					
	4x4		6x6		8x8	
	Diameter	Ratio to d.b.h.	Diameter	Ratio to d.b.h.	Diameter	Ratio to d.b.h.
0.5	5.2	1.24	6.9	1.28	7.6	1.29
[1]4.5	4.2	1.00	5.4	1.00	5.9	1.00
8.0	4.0	0.95	5.1	0.94	5.7	0.97
12.0	3.8	0.90	4.8	0.89	5.3	0.90
16.0	3.5	0.83	4.4	0.81	4.9	0.83
20.0	3.2	0.76	4.1	0.76	4.2	0.71
Cubic feet[2]	17.27		17.33		17.33	

1 *Average d.b.h. departs slightly from these shown in table 1 because of sampling error.*

2 *Total cubic feet outside bark per square foot of basal area in first 20 feet of stand height.*

There is a slight tendency for tree taper at 20 feet and butt flare at 0.5 foot to be greater on the wide spacings than on the close spacings. None of these differences is statistically significant, however.

For each square foot of basal area at breast height there were on the 4x4-, 6x6-, and 8x8-foot spacings 17.27, 17.33 and 17.33 cubic feet of volume, respectively, in the first 20 feet of stand height. These differences are again not significant. Apparently, the spacings used in this study make no practical difference in taper in the first 20 feet of stand height. On the more open spacings the slight loss of volume in the upper stems is offset by the volume contributed by greater butt flare.

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